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## ANALYSIS

# Is self monitoring of blood pressure in pregnancy safe and effective?

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## Abstract

Guidelines encourage the use of self monitoring of blood pressure in pregnancy, and research suggests that women prefer it. But **Hodgkinson and colleagues** explain that our enthusiasm may run ahead of the evidence and call for more research before it is routinely adopted

Self monitoring of blood pressure is increasingly popular with patients and healthcare professionals. Around a third of people with hypertension self monitor,<sup>1</sup> and measurements are more accurate than readings taken in clinic.<sup>2</sup> Anecdotal reports in the UK suggest that self monitoring in pregnancy is commonplace, although no studies have assessed this. A Canadian pilot survey found that two thirds of women with gestational hypertension were self monitoring.<sup>3</sup> Another small Canadian survey found that 78% of obstetricians used self monitoring in preference to ambulatory measurement to check for white coat hypertension in pregnant women with raised blood pressure.<sup>4</sup>

Blood pressure guidelines recommend home monitoring for pregnant women with chronic hypertension and poorly controlled blood pressure and for women with gestational hypertension—for example, the 2013 American College of Obstetricians and Gynaecologists guidelines<sup>5</sup>—so it is likely that the practice will become more common. The American Heart Association, American Society of Hypertension, and Preventive Cardiovascular Nurses Association joint statement<sup>6</sup> and European Society of Hypertension guidelines have highlighted the importance and potential of self monitoring blood pressure, with the American guidelines describing it as “theoretically ideal for monitoring changes in blood pressure during pregnancy.”<sup>7</sup>

Although home monitoring in pregnancy may have some advantages, there are still many unanswered questions about its use (box 1). We discuss the available evidence on self monitoring and suggest a way forward.

## How many women are affected?

Hypertensive disorders during pregnancy (box 2) are a leading cause of maternal mortality worldwide.<sup>8</sup> They are also associated with fetal growth restriction, low birth weight, preterm delivery, respiratory distress syndrome, and admission to neonatal intensive care.<sup>9</sup>

Substandard care has been identified in 46% of maternal deaths from pre-eclampsia and 65% of fetal deaths associated with pre-eclampsia.<sup>11</sup> In particular, failures to identify and act on known risk factors at booking appointments and to recognise and respond to signs and symptoms from 20 weeks' gestation have been noted.

A tenth of women have raised blood pressure (>140/90 mm Hg), with or without proteinuria, during pregnancy worldwide,<sup>12</sup> and the proportion of women with high blood pressure, and risk factors for high blood pressure, is increasing. Obesity, for example, is associated with a threefold increase in risk of pre-eclampsia,<sup>13 14</sup> and in the US the percentage of women who are obese (body mass index >30) or overweight (> 25) has increased almost 60% in the past 30 years. Similarly, advanced maternal age is associated with around a 50% increase of pre-eclampsia,<sup>15</sup> and the number of pregnant women over 40 in the UK has more than doubled in the past 24 years.<sup>16</sup>

**Box 1: Advantages and disadvantages of home monitoring of blood pressure in pregnancy***Potential advantages*

- Increased accuracy
- Patient friendly
- Potential to free healthcare professional time or reduce clinic visits
- Potential to identify white coat hypertension
- May reduce women's anxiety or medicalisation of care

*Potential disadvantages*

- Few monitors have been validated for use in pregnancy
- Poor understanding of normal blood pressure in pregnancy
- No diagnostic thresholds from home monitoring to identify pre-eclampsia or gestational hypertension
- False reassurance if woman with white coat hypertension subsequently develops true hypertension in pregnancy
- No evidence that earlier detection of high blood pressure through home monitoring will alter outcomes
- No evidence on optimal frequency and timing of home monitoring
- May increase women's anxiety or medicalisation of care

**Box 2: Types of hypertension during pregnancy**

*Chronic hypertension*—Blood pressure  $>140/90$  mm Hg before 20 weeks or being treated at time of referral to maternity services

*Gestational hypertension*—New hypertension presenting after 20 weeks without significant proteinuria

*Pre-eclampsia*—New hypertension presenting after 20 weeks of pregnancy combined with significant proteinuria (protein:creatinine ratio  $>30$  mg/mmol or validated 24 h urine collection containing  $>300$  mg protein)<sup>10</sup>

**Blood pressure in pregnancy**

Pre-eclampsia can manifest long before women experience physical symptoms,<sup>17 18</sup> and there is evidence that women in the UK develop the condition between antenatal visits. Of 383 women with confirmed eclampsia, 323 (85%) had been seen by a doctor or midwife in the week before their first convulsion, but at that point 36 (11%) had neither hypertension nor proteinuria, 32 (10%) had proteinuria but no hypertension, and 71 (22%) had hypertension alone.<sup>19</sup>

Current guidelines recommend blood pressure monitoring at routine antenatal visits with “increased frequency” for those at higher risk.<sup>20</sup> Comprehensive systematic reviews have not identified any specific screening test for pre-eclampsia (including those based on demographic characteristics, biomarkers, and ultrasound screening) that has sufficient accuracy or cost effectiveness to introduce into clinical practice. Consequently blood pressure monitoring in clinics remains the mainstay of pre-eclampsia detection in antenatal care.<sup>21</sup> Earlier identification of rising blood pressure in asymptomatic women would allow better targeting of resources at those in need of close monitoring, and self measurement between clinic appointments could facilitate this.

Clinic measurements are more vulnerable to error than out of office monitoring; more measurements can be made at home and white coat hypertension is avoided. The variability of blood pressure is heightened in pregnancy,<sup>22</sup> and debate continues about what constitutes normal blood pressure in pregnancy and how this may change by trimester. Reliance on clinic measurements could lead to unnecessary monitoring or missed opportunities to detect raised blood pressure, though there is no reliable evidence of this being the case. Data from ambulatory monitoring suggest that outcomes in women with white coat hypertension in pregnancy are similar to those with normal blood pressure.<sup>23</sup>

**Will women self monitor?**

We know pregnant women are willing to undertake repeated self measurements, comply with monitoring schedules,<sup>10</sup> and are able to accurately record blood pressure data.<sup>24</sup> It does not seem to increase anxiety,<sup>25</sup> even if more complex telemonitoring equipment is used.<sup>26 27</sup> Clinicians promoting self monitoring report being encouraged by women's cooperation, competence, and genuine desire to participate in their healthcare.<sup>28 29</sup> Over 98% of women with hypertension in pregnancy reported liking being involved in their blood pressure management.<sup>3</sup>

Self monitoring of blood pressure in pregnancy is more acceptable to pregnant women than more frequent clinic visits,<sup>30</sup> hospital admission,<sup>27</sup> or ambulatory monitoring.<sup>31 32</sup> Among 78 healthy pregnant women who evaluated both home and ambulatory monitors at 35-37 weeks' gestation, 74 (95%) found self monitoring of blood pressure (using Omron HEM705CP) acceptable compared with 61 (78%) for 24 hour ambulatory monitoring.<sup>33</sup> Home monitoring caused less discomfort and rarely interfered with activities or disturbed sleep.

**Is self monitoring accurate?**

Despite the large number of home monitors available, few are validated and deemed accurate for use in pregnancy and pre-eclampsia. Specific validation of monitors in pregnant women is important because several monitors validated for general use have been found to be inaccurate, mostly because of falsely low readings.<sup>34 35</sup> Five monitors have been validated for home use in pregnancy using widely accepted protocols.<sup>36-40</sup> But even validated monitors may not be accurate for all pregnant women—for example, when the accuracy of three commercially available devices was tested on 55 pregnant women with upper arm circumference  $>35$  cm, none was accurate.<sup>41</sup>

**How should self monitoring be done?**

In essential hypertension, self monitoring for a minimum of three days and ideally seven days is currently recommended,

although the evidence underlying this is not particularly compelling.<sup>42</sup> Conclusions from ambulatory monitoring in pregnancy suggest that a blood pressure of 135/85 mm Hg best predicts future pregnancy induced hypertension, but the threshold has not been established firmly.<sup>43 44</sup> Clear self monitoring thresholds for hypertension in pregnancy have not been established.<sup>42 45</sup> Few data are available comparing clinic thresholds with self monitored blood pressure in pregnancy, and the studies they are drawn from have important methodological weaknesses.

At a more basic level incomplete understanding of normal blood pressure in pregnancy means that any monitoring in pregnancy is challenging. Blood pressure changes through the trimesters, falling and then rising again; thus, a woman could have a blood pressure that starts at 100/70 mm Hg, falls in mid-trimester to 90/60 mm Hg, and then rises to 135/85 mm Hg (for example) but still be considered within normal limits (<140/90 mm Hg by clinic measurement). It is unclear whether monitoring frequency should change if blood pressure rises notably but remains below the threshold of 140/90 mm Hg.<sup>46</sup> Despite this, at present only the 140/90 mm Hg threshold is accepted for all trimesters.<sup>10</sup> Women with pre-existing hypertension may have more unpredictable blood pressure in pregnancy because of stopping treatment or changing to safer medicines in early pregnancy.

In the absence of clear evidence, there is little guidance on how often blood pressure should be measured. The US guidelines recommend that in women with hypertension before pregnancy “the diagnosis should be confirmed by multiple measurements and may incorporate home or other out-of-office blood pressure readings,” but they do not say what this means practically—for example, how frequently blood pressure should be measured.<sup>47</sup> NICE guidelines on hypertension in pregnancy conclude that research is needed to determine the optimal frequency and timing of measurement as well as on the best way to detect proteinuria in women who have existing hypertension or other known risk factors for pre-eclampsia.<sup>48</sup>

## Does self monitoring affect pregnancy outcomes?

It is not known whether self monitoring will alter outcomes. In the UK, a pilot randomised controlled trial in 80 low risk women included weekly self monitoring combined with a reduced antenatal visit schedule.<sup>49</sup> A larger trial did not go ahead, perhaps because the predicted number of low risk women required to determine a significant effect was 10 000. A future trial may be better to focus on the role of self monitoring in a higher risk group, which would need fewer women because they would be more likely to benefit.<sup>50</sup>

Few data exist on the safety of self monitoring, but there are conflicting reports regarding how well women follow instructions from healthcare professionals.<sup>30 51</sup> In one small study, women who recorded their own blood pressure responded appropriately by contacting healthcare professionals when repeated readings were persistently raised.<sup>52</sup> However, researchers found 10 out of 21 pregnant women in another study<sup>36</sup> had poor understanding of the instructions given about the importance of alerting midwives when their blood pressure was raised above a threshold. Problems included language barriers and personal or work commitments.

## The bottom line

Self monitoring of blood pressure seems to be feasible and acceptable to pregnant women. It might make antenatal care more effective, but we need further research to establish safety and efficacy, the impact on women and health professionals, and how best to use the results. If self monitoring becomes widely used within healthcare systems, such research may be difficult to undertake. We believe that until the evidence base is considerably stronger, further implementation of self monitoring of blood pressure in pregnancy, at least formally by the NHS, should be delayed.

Nevertheless, the trend towards self monitoring is set to increase, and it is important to acknowledge this and respect people's choices. General practitioners and midwives need to be sensitive to this, and could ask women in their care whether they are self monitoring and, if so, whether they would like to share the results or receive any help interpreting them. They should also discuss the uncertainty around how the results are best interpreted.

**Contributors and sources:** All authors are members of the Blood Pressure Monitoring in Pregnancy Research Group (BUMP). JAH and KLT are research fellows in primary care; RJMcM and CH are academic GPs; CC and MS are both midwives and researchers; SMG, LH, and LL are qualitative researchers with expertise in personal experiences of health and illness; KK, LM, and CMC work in obstetrics and maternal health. Key studies were identified from Medline searches up to March 2014, without limiting by publication date or language and searches of BHS and dabl websites. JAH, KLT, and RJMcM wrote the first draft of the article, and subsequent drafts were edited for critical content by all. RJMcM is guarantor.

**Competing interests:** We have read and understood BMJ policy on declaration of interests and declare the following interests: RJMcM is a member of the NIHR HTA Trials Board and has received blood pressure monitoring equipment for research studies from Omron and Lloyds Pharmacy.

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